B7

VOLUME B: AIRPORT AND SURROUNDS

Surface Hydrology

Surface Hydrology

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KEY FINDINGS

Baseline Conditions (refer to Figure 7.1)

- Brisbane Airport and the New Parallel Runway (NPR) site is located adjacent to the Kedron Brook Floodway and within the Kedron Brook floodplain area to the east of the Gateway Motorway;
- During large regional flood events, the capacity of Schulz Canal (which feeds into the Kedron Brook Floodway upstream) is insufficient to contain flow within the banks of the main channel and significant out-of-bank flow (overland flow) occurs in floodplain areas on the east and west of the main channel, downstream of the Gateway Motorway. A large regional flood event will also overflow the banks of Kedron Brook Floodway into Nudgee Golf Course;
- Overland flow during large regional flood events moves through a low-lying floodplain area of Brisbane Airport, west of Airport Drive and Dryandra Road. Flow travels through the Landers Pocket Drain, Serpentine Creek and Jacksons Creek systems, and enters Kedron Brook Floodway near the mouth at Moreton Bay.

Impact Assessment (refer to Figure 7.1)

- The flooding characteristics following development of the NPR are similar to those experienced under Baseline Conditions;
- The NPR development includes a Kedron Brook Floodway Drain, a diversion of Landers Pocket Drain to Kedron Brook Floodway;
- Kedron Brook Floodway Drain intercepts regional overland flow that moves through the floodplain area of Brisbane Airport and the Landers Pocket Drain, Serpentine Creek and Jacksons Creek systems and diverts the flow to Kedron Brook Floodway;
- Numerical modelling indicates that flooding impacts from development of the NPR are negligible to minor and are experienced locally around the confluence of Kedron Brook Floodway Drain and Kedron Brook Floodway;
- Modelling shows that development of the NPR does not result in increased maximum flood levels upstream of the start of Kedron Brook Floodway, and accordingly the modelling indicates that there would be no impact to existing off-airport residential and commercial developments;
- Minimal change to flow velocities within the Kedron Brook Floodway and overland flow regimes that are not sufficient to cause additional bed and bank scour.

7.1 Site Description

7.1.1 Kedron Brook Catchment

The Kedron Brook catchment measures approximately 104 km^2 in area and 25 km in length and is bounded by the catchments of Enoggera Creek (south) and Cabbage Tree and Downfall Creeks (north). The catchment extends from Ferny Hills to the Brisbane Airport site and contains significant areas of residential and commercial development. There is generally only limited opportunity for future infill development within the existing development areas.

The headwaters of the Kedron Brook are in the State Forest and Brisbane Forest Parks, within the suburbs of Ferny Hills and Upper Kedron. The Kedron Brook forms the suburb boundary for numerous suburbs including Mitchelton, Enoggera, The Grange, Lutwyche, Kedron, and Nundah. Along the length of Kedron Brook, Brisbane City Council has constructed interconnecting parklands. Several tributaries enter Kedron Brook along its length including Battery Drain, Cannery Creek and Pound Drain (refer to **Figure 7.1**).

At the lower end of the catchment, engineered tidal channels have been constructed to direct flow from Kedron Brook to a coastal discharge location. Schulz Canal and Kedron Brook Floodway convey flow from Kedron Brook to Moreton Bay. Battery Drain, Cannery Creek and Pound Drain branches of the Kedron Brook system discharge to Schulz Canal directly upstream of Kedron Brook Floodway.

Brisbane Airport is located in a floodplain area at the lower end of Kedron Brook Catchment, directly adjacent Kedron Brook Floodway. Brisbane Airport forms part of the hydraulic network of tidal and flood flows of the lower catchment which also includes:

- Schulz Canal;
- Kedron Brook Floodway;
- Battery Drain;
- Pound Drain;
- Cannery Drain; and
- Floodplain areas located both sides of Kedron Brook Floodway.

7.1.2 Brisbane Airport Site

The Brisbane Airport is located within the north-eastern region of Brisbane, approximately 13 km from the Brisbane Central Business District (CBD). The Airport lies between Kedron Brook Floodway to the west, Boggy Creek to the south and the Brisbane River to the east. The northern boundary of the Airport forms the shoreline of Bramble Bay, one of three embayments that form the western perimeter of Moreton Bay. The Airport site is characterised by topography with very little surface relief and low surface elevations.

Brisbane Airport is drained though a series of interconnecting engineered and remnant tidal channels, including:

- Boggy Creek to Brisbane River;
- A series of constructed tidal drains including Schulz Canal, Landers Pocket Drain and Serpentine Creek Diversion;
- The remnant tidal channels of Jacksons Creek and Serpentine Creek draining to Kedron Brook Floodway; and
- Jubilee Creek directly to Bramble Bay.

Prior to construction of the existing airport infrastructure, the airport site consisted of mangrove lined, tidal channels draining both local and regional catchments towards Moreton Bay. Typical of the low lying, estuarine environment, local catchment areas across the site were poorly defined and flow paths for large flood events were not contained within the natural channels. Major flood events overtopped the existing creeks and flowed slowly across the flat topography, generally towards Moreton Bay.

Construction of the existing runway and terminal areas in the 1980s changed the natural drainage paths on the site. Existing airport infrastructure is constructed on fill platforms that elevate the ground above the level of the surrounding floodplain. Construction of the fill platforms severed a number of natural waterways, and engineered tidal channels were constructed to provide connectivity between remnant channel reaches that remained outside the development footprint of the existing aiport. This airport construction was completed after extensive flood modelling and subsequent construction of the Kedon Brook Floodway to convey flood flows (see section 7.1.4 below for more detail).

Filling and construction has modified the site such that floodplain areas on the western side of Airport Drive have little interaction with existing aiport infrastructure on the eastern side of Airport Drive.

Battery Drain is the only major waterway that crosses Airport Drive. A number of minor local airport drainage systems cross Airport Drive in the passenger terminal precinct.

7.1.3 New Parallel Runway Site

The NPR site is a modified site, located west of Airport Drive, adjacent to the Kedron Brook Floodway. The site includes a number of remnant tidal channel reaches (Serpentine Creek, Jacksons Creek) and engineered tidal channels (Landers Pocket Drain, Serpentine Creek Diversion) constructed to maintain connectivity of remnant waterways (refer **Figure 7.1**).

Kedron Brook Floodway is a large engineered channel at the lower end of Kedron Brook Catchment designed to convey large flood flows associated with regional flood events and minimise upstream flood impacts (refer section 7.1.4). Kedron Brook Floodway commences downstream of the Gateway Motorway, at the downstream end of Schulz Canal and is an engineered channel diversion of Kedron Brook.

The Landers Pocket Drain system (including Landers Pocket Drain, Serpentine Creek, Serpentine Creek Diversion and Jacksons Creek) has local and regional drainage significance. The waterway system provides local drainage of existing airport infrastructure, including passenger terminal facilities, the general aviation area and the northern end of the existing 14/32 runway. The Landers Pocket Drain system also provides capacity for conveyance of regional flooding to coastal discharge at Moreton Bay.

7.1.4 Kedron Brook Floodway

Kedron Brook Floodway is an engineered tidal channel that was constructed as a diversion around the existing airport when it was developed in 1983. The Floodway is 6 km in length, approximately 2.0 m deep (below Mean Low Water Neap (MLWN)) and varies in width from 90 m at the upstream end to 230 m at the outlet into Moreton Bay. Kedron Brook Floodway is connected to Kedron Brook via Schulz Canal, a section of engineered tidal channel that extends from the start of the floodway to the Kedron Brook upstream of the Gateway Motorway.

Prior to the construction of the existing aiport, Kedron Brook flowed directly into Serpentine Creek which discharged into Moreton Bay. The site filling and the realignment of several major creek systems during the existing aiport construction required flow from Kedron Brook to be diverted around the aiport site and discharged directly into Moreton Bay.

In late 1978, the Government Coordinating Committee of the Brisbane Airport Redevelopment Project produced a set of design criteria for the Kedron Brook Floodway based upon a *"no worsening of flooding outside Commonwealth Airport Land".*

The design criteria included a peak design discharge of 740 cubic metres per second (m^3/s). This discharge corresponded to an estimated flood return period of one in 100 years. The layout, location and design of the Kedron Brook Floodway incorporated the original planning for the parallel runway system, including separation of the NPR from the existing 01/19 runway of approximately 2,000 m.

The Kedron Brook Floodway was constructed using a dredge and the dredge spoil was deposited on the NPR site, adjacent to the floodway. There has been some minor sedimentation within the floodway since construction and in 1995 the floodway was dredged to remove deposited sediments and maintain its hydraulic capacity. The dredging was commissioned by the Commonwealth prior to Brisbane City Council adopting responsibility for the floodway.

7.2 Study Area

The study area for the assessment of surface water hydrology and hydraulic impacts from the NPR project includes major waterways and floodplain areas interacting with the site. The study area, shown on **Figure 7.2** includes:

- The extents of Kedron Brook Floodway and Schulz Canal;
- Tributaries of Schulz Canal including Battery Drain, Pound Drain and Cannery Creek;
- The Landers Pocket Drain system, including Serpentine Creek, Serpentine Creek Diversion and Jacksons Creek;
- The floodplain areas either side of Kedron Brook Floodway;
- Existing aiport infrastructure, including the existing runway and taxiway infrastructure; and
- The site of the proposed NPR.

Kedron Brook Floodway is the primary drainage path for flood flows from Kedron Brook catchment. The NPR site is located in the floodplain of the Kedron Brook Floodway and is the principal focus of hydrologic and hydraulic assessment.

7.3 Proposed Development

The NPR project involves placing large areas of sand fill adjacent to the Kedron Brook Floodway, close to the outlet of the floodway into Moreton Bay. The sand fill platforms aim to elevate runway and taxiway infrastructure above flood and storm tide levels and provide suitable subgrade for runway and taxiway pavement construction.

Placing fill over the runway site will result in changes to the current drainage system and will involve filling and diverting many existing engineered and remnant tidal channels. The local drainage network on the NPR site requires modification to accommodate these changes and ensure that flood immunity of existing infrastructure is preserved.

In addition to local drainage effects, reduction of floodplain storage in the lower Kedron Brook Catchment (associated with filling for the NPR construction) has the potential to influence regional flood behaviour. These potential impacts are considered in assessment of the NPR (refer to section 7.8).

An outline of the development is provided in **Figure 7.3a** and a detailed description of the NPR and its construction is provided in Chapters A4 and A5 (respectively).

7.3.1 Major Drainage

Major tidal channels are provided to (i) redirect flood flows around the NPR and (ii) provide a discharge location for local airport drainage (refer to **Figure 7.3b**). The major drains include Kedron Brook Floodway Drain (discharging to Kedron Brook Floodway) and Serpentine Inlet Drain (discharging to Serpentine Inlet).

7.3.1.1 Kedron Brook Floodway Drain

The runway construction will intersect with the existing Landers Pocket Drain and prevent it connecting with the remnant Serpentine Creek/ Jacksons Creek system. A major diversion, the Kedron Brook Floodway Drain is proposed immediately south of the NPR that connects Landers Pocket Drain with the Kedron Brook Floodway. The Kedron Brook Floodway Drain will also provide a discharge location for local airport drainage of the southern end of the NPR and existing local airport stormwater infrastructure at the rear of the domestic terminal building and car park.

7.3.1.2 Serpentine Inlet Drain

Serpentine Inlet is the current discharge location for the existing Serpentine Inlet Drain and Airside Drain, servicing existing airfield infrastructure. The existing Serpentine Inlet Drain provides drainage for stormwater from very small catchments adjacent the existing 14/32 runway, while Airside Drain provides drainage of the existing domestic terminal apron and existing runway and taxiway infrastructure.

Augmentation of Serpentine Inlet Drain will provide drainage for the northern part of Brisbane Airport (north of the new link taxiway), including the northern part of the NPR, the general aviation area and the Future Aviation Facilities Area (FAFA).

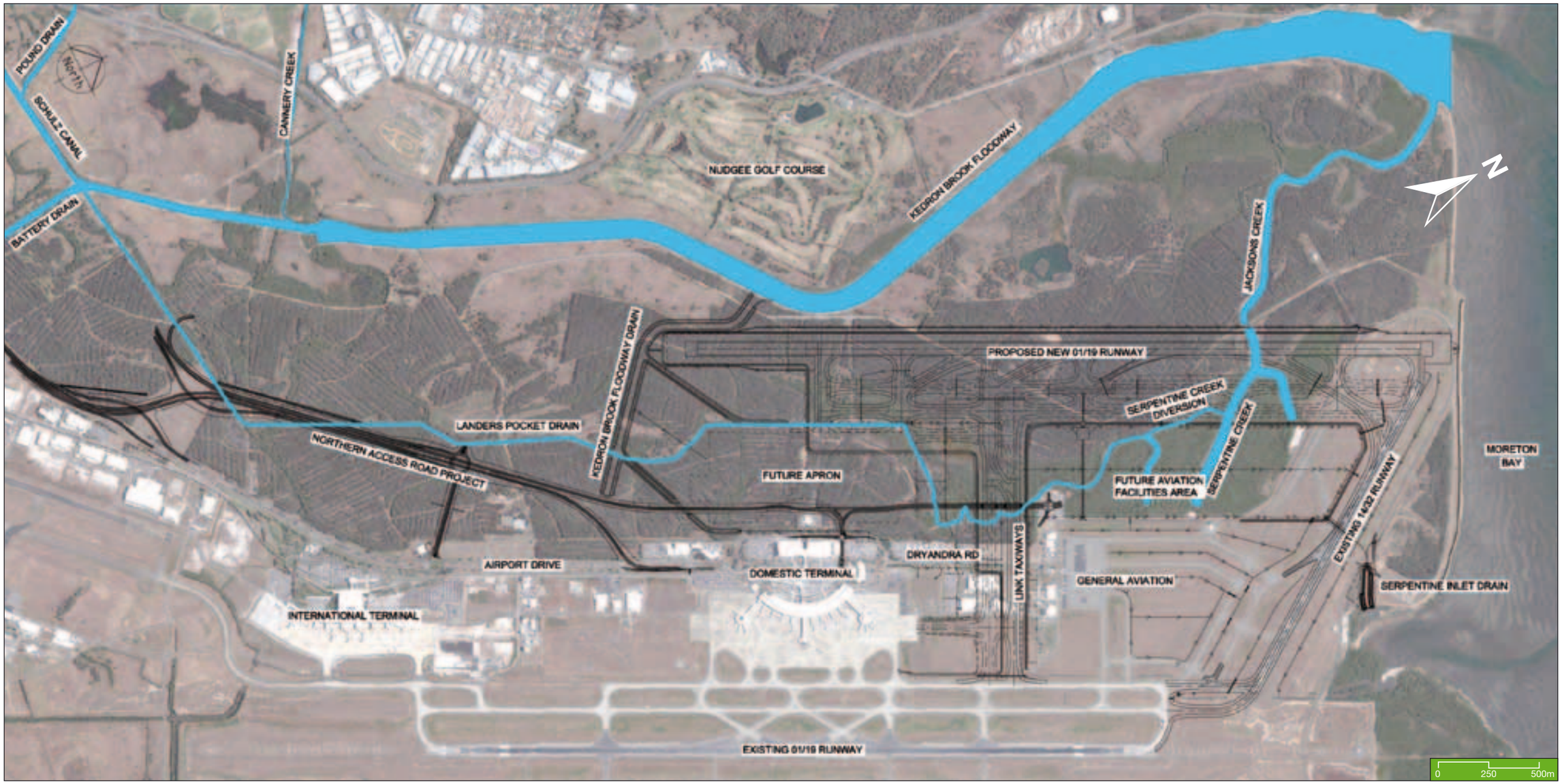
Figure 7.3c shows a cross-section of the existing Serpentine Inlet Drain and also the new Serpentine Inlet Drain.

7.3.2 Local (On-Airport) Drainage Network

The layout, geometry and operation of the NPR dictate constraints for conveyance, storage and treatment functions of local airport drainage infrastructure. The local drainage infrastructure includes open swales and drains with grassed buffers. Local drainage of the NPR is predominantly elevated above tidal influence. Tidal drainage is incorporated into the layout where the local drainage network connects to the major drains (Kedron Brook Floodway Drain and Serpentine Inlet Drain).

Due to the layout of the runway and taxiway system, detention storage areas are created between the pavement sections that make up the taxiways and runway. The detention areas coupled with correctly sized culverts beneath the runway and taxiways effectively attenuate the peak stormwater flow rate discharged through the local airport drainage system. Culvert outlets from the detention storage areas are sized to provide maximum storage within the available area during local storm events while adhering to the relevant safety and design criteria that apply to the runway and taxiway layouts. The maximum ponding time within the detention storage areas is less than 12 hours, consistent with the design criteria outlined in the Brisbane Airport Master Drainage Study (1999).

Figure 7.1: *Existing Major Waterways within the Study Area.*

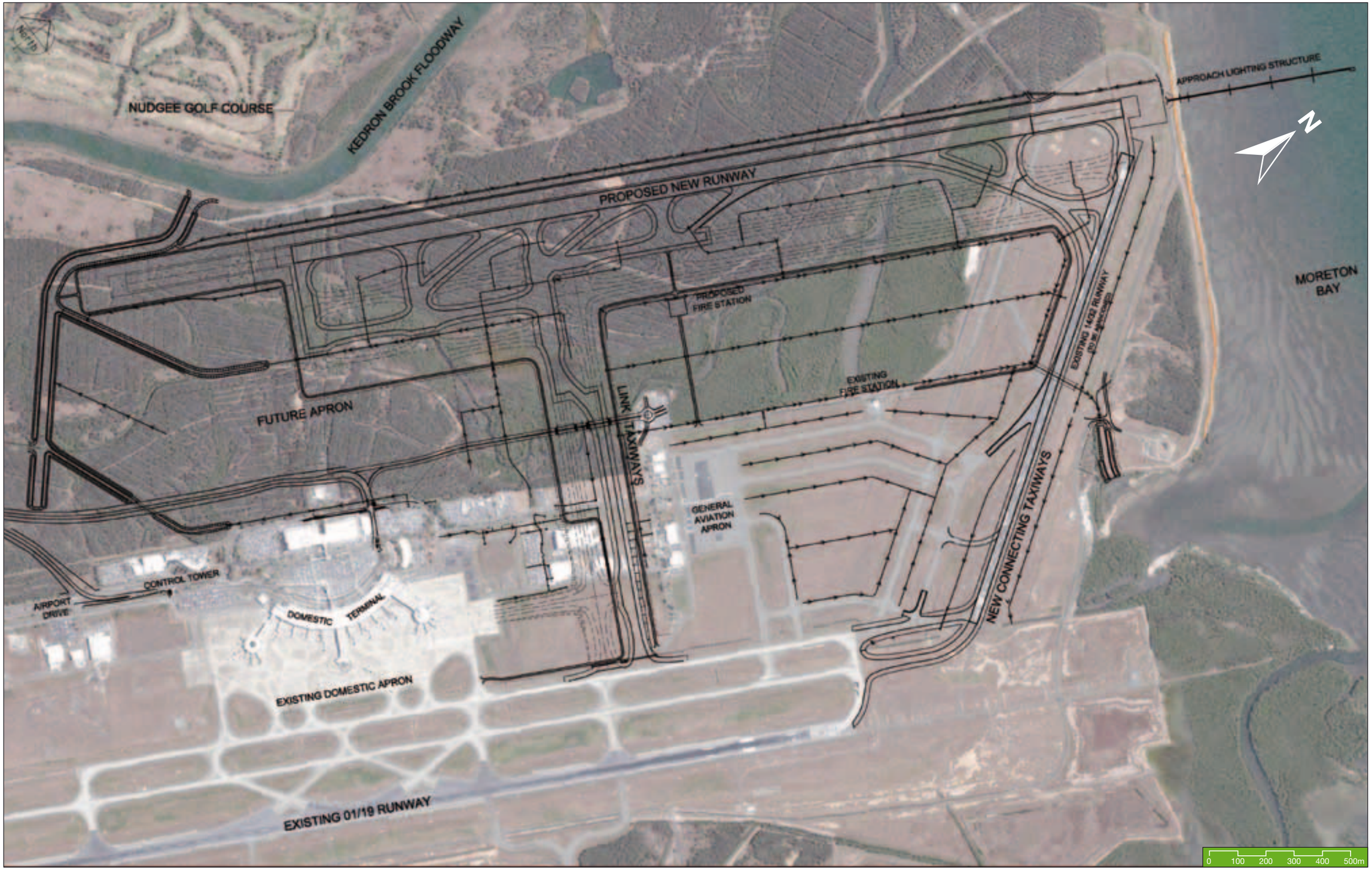


NEW PARALLEL RUNWAY DRAFT EIS/MDP
FOR PUBLIC COMMENT

Figure 7.2: *Kedron Brook Catchment and NPR Study Area.*

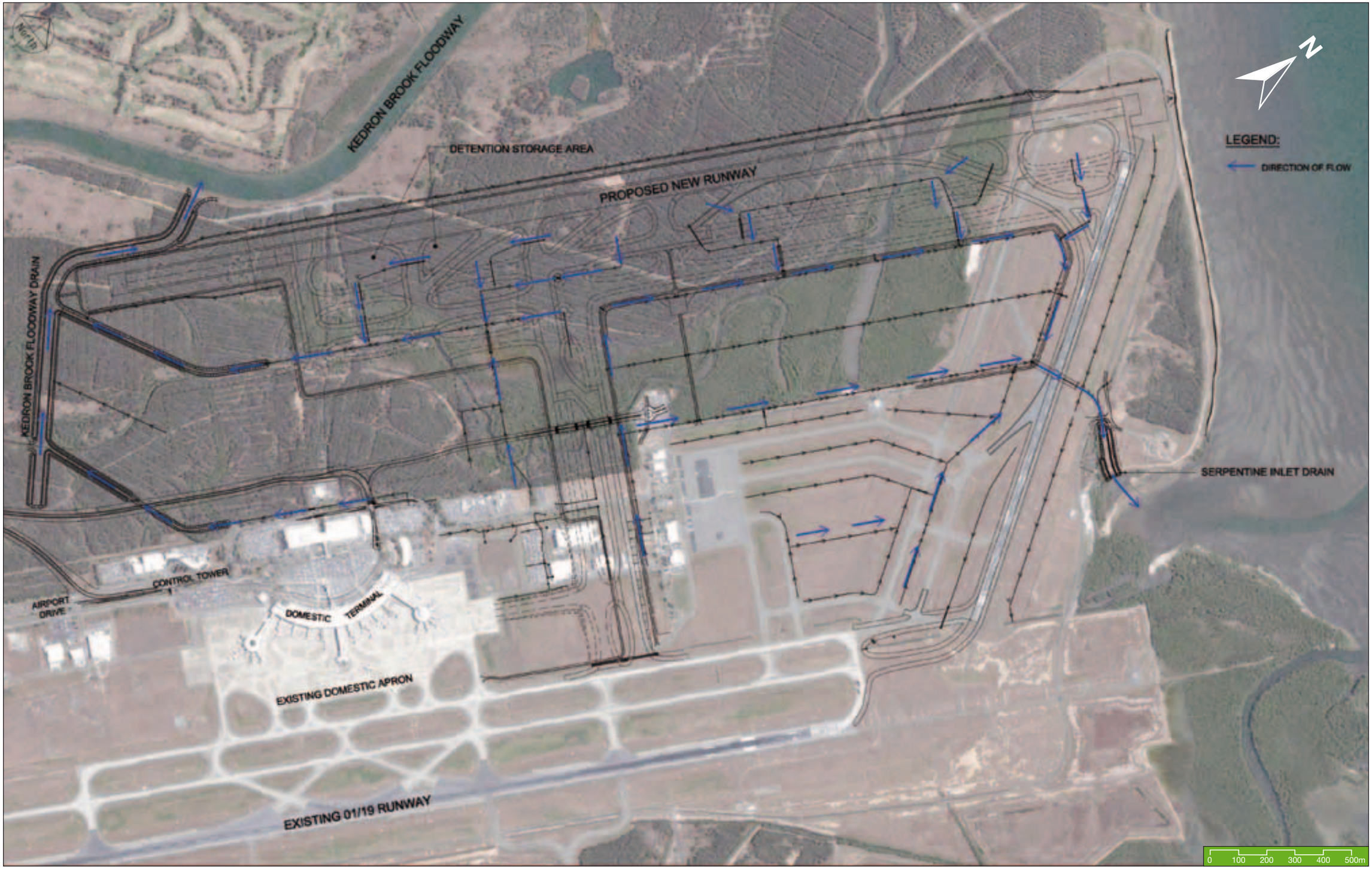
NEW PARALLEL RUNWAY DRAFT EIS/MDP
FOR PUBLIC COMMENT

Figure 7.3a: *NPR and Taxiway Layout.*



NEW PARALLEL RUNWAY DRAFT EIS/MDP
FOR PUBLIC COMMENT

Figure 7.3b: *Drainage Routing Scheme.*



NEW PARALLEL RUNWAY DRAFT EIS/MDP
FOR PUBLIC COMMENT

Figure 7.3c: *Serpentine Inlet Drain (Existing and Proposed).*

7.4 Methodology

The assessment of surface water hydrology and hydraulics was carried out as part of the preliminary design of the NPR. The assessment was carried out in order to define the formation levels for the runway and taxiway pavements and to determine the impacts of the NPR on the existing flood conditions within the lower Kedron Brook Catchment. The hydrology and hydraulic assessments were based on numerical modelling.

7.4.1 Hydrologic Assessment

Hydrology in the context of this study describes the interaction between rainfall and the topographic surface that produces runoff as overland flow and stream flow within a catchment. An assessment of the hydrology of Kedron Brook catchment was carried out to determine the appropriate stream flow inputs to the hydraulic modelling.

The hydrologic assessment for the NPR consisted of two components, namely (i) regional hydrology and (ii) local (on-airport) hydrology. The regional assessment accounted for the hydrologic processes within the broader Kedron Brook Catchment, and established stream flow for major waterways within the study area, including Schulz Canal, Pound Drain, Cannery Creek and Battery Drain. The local assessment accounted for hydrologic processes of on-airport catchments and catchments influencing local airport drainage systems.

Assessment of regional hydrologic processes of Kedron Brook Catchment is documented in the Kedron Brook Flood Study (1995). Kedron Brook Flood Study (1995), commissioned by Brisbane City Council, provides a comprehensive hydrologic and hydraulic assessment of Kedron Brook Catchment, based on calibrated and validated numerical modelling. The outcomes of numerical modelling undertaken as part of the Kedron Brook Flood Study have been adopted in this assessment to establish regional stream flow for Schulz Canal, Pound Drain, Battery Drain and Cannery Creek, based on ultimate development within the Kedron Brook Catchment.

Hydrologic assessment of existing local airport drainage systems (based on numerical modelling) has been undertaken and documented as part of the Brisbane Airport Master Drainage Study (1999). The outcomes from this hydrologic assessment were adopted to establish stream flow for existing airport drainage infrastructure that is maintained following development of the NPR.

Development of the NPR defines new on-airport drainage catchments within the NPR site and changes the definition (boundary) of some existing airport drainage catchments and the characteristics of some existing airport drainage catchments. Numerical hydrologic models were developed to establish stream flow for new local drainage catchments defined by the NPR construction. The models were applied where the boundary or characteristics of existing airport drainage catchments are changed by the NPR construction. Numerical hydrologic models were constructed using XP-RAFTS (Version 6.0), in accordance with Australian Rainfall and Runoff (1987).

7.4.2 Hydraulic Assessment

The hydraulic assessment considers the movement of water through the channels and floodplains and defines flood levels, discharge and flow velocity throughout the study area. Numerical hydraulic modelling of waterways and floodplains was used during the flooding assessment for the NPR to define flood levels, discharge and flow velocity and to provide the basis for developing and understanding of the hydraulic characteristics of the site.

The numerical hydraulic modelling utilised a one-dimensional model coupled with a two-dimensional hydraulic model to represent channels and floodplains. The use of a coupled model system allows channel flows to be simulated with greater resolution in the one-dimensional model component and overland and floodplain flow to be simulated in the two-dimensional model component. The MIKEFLOOD modelling software from DHI Water and Environment was used for developing the model. The model is based on a coupling of the one-dimensional (MIKE11) and two-dimensional (MIKE21) models. The two models represent industry standard software packages that are widely used in Australia by consulting organisations, state

governments and local authorities. This software is appropriate for modelling the flooding and hydraulic impacts of this project.

Hydraulic modelling of the existing conditions was carried out to identify baseline hydraulic conditions of channels and floodplains that interact with the site of the proposed NPR. The model representing existing conditions includes Kedron Brook Floodway, Landers Pocket Drain, the lower reaches of Battery Drain and Pound Drain, Cannery Creek, the floodplains of Kedron Brook downstream of the Gateway Motorway and the drainage system of the existing airport.

Existing development of Brisbane Airport and the lower Kedron Brook Catchment were represented in hydraulic models used to define the baseline flooding conditions. Stream flow inputs (from the hydrologic assessment, refer section 7.4.1) to the baseline hydraulic assessment assume ultimate development within the upper Kedron Brook Catchment (upstream of the Gateway Motorway), in accordance with the assessment presented in the Kedron Brook Flood Study (1995). This assumption of ultimate development within the catchment provides an estimate of the maximum stream flow that may occur in the future and is consistent with Brisbane City Council catchment land use planning.

7.4.3 Development Scenarios for Assessment of Surface Water Hydrology and Hydraulics

The impact on surface water hydrology and hydraulics from development of the NPR was determined through comparison of the outcomes of numerical modelling. Models depicting development scenarios within the lower Kedron Brook Catchment were used to predict the hydraulic response under existing conditions and developed conditions.

The following scenarios were used in the assessment:

- Existing Development Conditions (Baseline Conditions, refer section 7.6), defining the baseline hydrologic and hydraulic conditions within the study area; and
- NPR Developed Conditions (Developed Conditions, refer section 7.8), defining the hydrologic and hydraulic conditions with development of the NPR.

The baseline conditions were represented in a model with existing development in the lower catchment defined by the existing waterways, topographic surface and hydraulic structures, but assumed ultimate development conditions in the upper catchment for modelling of the rainfall and associated stream flow response.

The development of the NPR was depicted in a model that included the new waterways, the new topographic surface and the new hydraulic structures associated with development of the NPR. The hydraulic impact from development of the NPR is defined by the difference between existing (baseline) hydraulic conditions and the developed conditions.

The hydrologic and hydraulic characteristics associated with each of these development scenarios are discussed in sections 7.6 and 7.8 respectively. Assessment of the cumulative impacts from development of the NPR in combination with other developments within the study area is discussed in section 7.9.

7.5 Limitations and Assumptions

7.5.1 Model Calibration

Model calibration is carried out wherever possible during model development to verify that the model is reliably reproducing the observed physical behaviours of the system. The calibration typically involves a comparison of observed water levels and flow rates with water levels and flow rates predicted by model simulations.

Calibration and validation of the hydrologic model was undertaken during the Kedron Brook Flood Study (1995). Accordingly, the hydrologic assessment of the Kedron Brook Flood Study that was adopted for assessment of regional hydrology in this study has been calibrated and accepted.

The hydraulic models developed during preliminary design of the NPR are not calibrated to observed flood events. Calibration of the hydraulic model requires flood level records within the study area. There are no records of flood levels within the study area for this assessment (downstream of the Nudgee Road crossing of Schulz Canal). A number of flood level recorders maintained by Brisbane City Council are located on Schulz Canal upstream of Nudgee Road, however there have been no significant flood events to reliably provide observed flood levels under the current catchment conditions.

Accordingly, the methodology for definition of baseline surface water conditions and assessment of impacts from development of the NPR is not able to include formal calibration of the hydraulic model. A sensitivity analysis was carried out to ensure that the model predictions were relatively stable and consistent for potential variation in model parameters such as channel roughness.

The results from the model can be used to assess the relative change in hydraulic characteristics associated with alternative development scenarios with reasonable reliability, however the absolute magnitude of the results must be considered carefully in the absence of a model calibration.

The model results for the 100 year regional flood event were applied in a comparison with results from the Kedron Brook Flood Study (1995). Refer to section 7.8 for details of the model comparison.

7.5.2 Channel Morphology

For the baseline scenario, the topographic and bathymetric surface utilised in this model depicts existing surface elevations throughout the study area (with the exception of the Kedron Brook Floodway channel geometry). This model surface was sourced from:

- Current survey data (North Surveys, 2005);
- Current cross-sectional survey of all waterways and drains (North Surveys, 2005);
- Cross-sectional survey of Kedron Brook Floodway undertaken in 1994, which was provided by Brisbane City Council (survey undertaken by Commonwealth); and
- Cross-sectional information from the Kedron Brook Flood Study (1995).

The 1994 cross-sectional data for the Kedron Brook Floodway was compared to bathymetric survey undertaken by North Surveys (2005). The 1994 survey data was collected prior to maintenance dredging undertaken by the Commonwealth in 1995. The data shows a reduced cross-sectional area, attributed to the build up of silt and sediments on the base of the floodway. Following discussions with Brisbane City Council, the 1994 cross-sectional data was used in the baseline scenario to model a conservative hydraulic capacity of the Kedron Brook Floodway.

For the post-development scenarios, the topographic surface for the baseline scenario was updated to represent the proposed NPR development. The post development scenario also included the 1994 cross-sectional data for the Kedron Brook Floodway.

For both pre-and post-development scenarios, the channel geometry in the hydraulic models is fixed and does not account for morphological processes that have long term influence on channel geometry.

7.5.3 Hydrological Data from the Kedron Brook Flood Study

The hydrological data from the Kedron Brook Flood Study (1995), commissioned by Brisbane City Council, was used as an input into the NPR hydraulic model. This data forms the basis of accepted flood characteristics within the Kedron Brook Catchment. Limitations of the use of the information are consistent with the modelling limitations of the Kedron Brook Flood Study (1995).

7.5.4 Existing Hydraulic Models

The existing airport site and surrounds have been the subject of many drainage assessments since the original planning. The most extensive of these, the Kedron Brook Flood Study (1995) and the Brisbane Airport Master Drainage Study (1999), included the construction of a large drainage model that included all existing drainage features (culverts, drains, etc.) from the site using a one-dimensional drainage model (Rubicon).

While the modelling methodology used in this assessment differed from that of the existing studies, the information on the physical drainage features contained within the existing models remains constant and this has allowed details from the two existing models to be used extensively in the construction of new models of the existing drainage system. The existing models were used as the source data for all existing drainage channels, drainage culverts and structures and other drainage infrastructure within the study area. The relevant information on drainage structures, culverts and drainage profiles from the existing hydraulic models was transformed into MIKE11 format and included in the preliminary design hydraulic model.

7.5.5 Geographical Extent of Model

The two-dimensional component of the model developed for the preliminary design of the runway project extends to the Gateway Motorway. The extent of the model was sufficient to identify the impact of the runway development on the surrounding development for the purposes of design.

7.6 Baseline Conditions

7.6.1 Regional Flooding

The site of the NPR has significant interaction with the Kedron Brook Floodway and Landers Pocket Drain during regional flood events. Kedron Brook Floodway carries the majority of flood flows during regional flooding events. A significant overland flood flow also occurs through the Landers Pocket floodplain area (to the east of the Kedron Brook Floodway) during these events.

7.6.1.1 Flood Inundation

A 100 year Average Recurrence Interval (ARI) regional flood results in substantial inundation throughout the lower Kedron Brook floodplain and the Landers Pocket floodplain area. The baseline (existing condition) maximum flood depth for a 100 year ARI regional flood event with Mean High Water Spring (MHWS) tailwater condition is presented in **Figure 7.6a**.

Inundation downstream of the Gateway Motorway occurs in five key areas, including:

- The floodplain area west of Schulz Canal, bounded by the Gateway Motorway;
- The floodplain area east of Schulz Canal, bounded by Airport Drive and the Gateway Motorway;
- The Landers Pocket area adjacent Landers Pocket Drain, bounded by Airport Drive;
- The Nudgee Golf Course Floodplain area; and
- Adjacent to Battery Drain, upstream of Airport Drive.

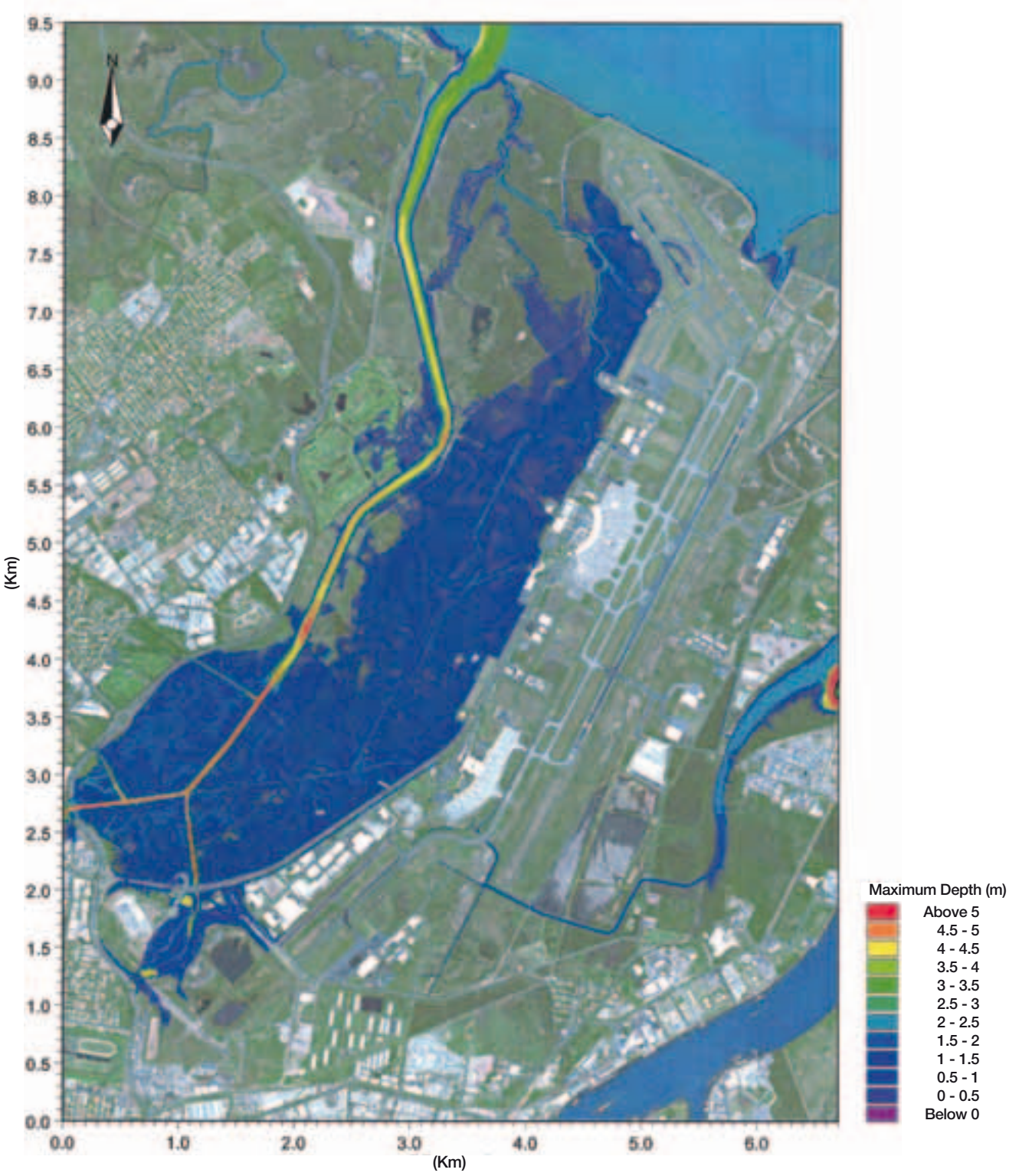
The hydraulic capacity of Schulz Canal downstream of the Gateway Motorway is insufficient to provide conveyance of the design 100 year ARI regional flood, resulting in significant out-of-bank (overland) flow through the adjacent floodplain areas.

Overland flood flow on the western side of Schulz Canal is confined by the alignment of the existing Gateway Motorway and moves parallel to the channel toward the inlet to the Kedron Brook Floodway. The overland flow is diverted back to the floodway inlet due to the alignment of the Gateway Motorway road embankment, which converges towards the floodway. The hydraulic capacity of Kedron Brook Floodway is significantly larger than Schulz Canal and provides sufficient capacity for these flows to be carried within the banks of the main channel.

Overland flood flow on the eastern side of Schulz Canal is confined by the alignment of Airport Drive and moves parallel to the channel towards the confluence of Schulz Canal and Landers Pocket Drain. Flood flows are then partially diverted into the Landers Pocket Drain and the low lying areas of Landers Pocket floodplain. A proportion of the overbank flood flow is diverted back into the Kedron Brook Floodway at the inlet structure. The majority of the overland flow on the eastern side of Schulz Canal drains through the Landers Pocket area adjacent Airport Drive and eventually discharges into Serpentine Creek.

Flow through the Serpentine Creek system continues through to the main channel of Jacksons Creek and discharges near the mouth of Kedron Brook Floodway. Discharge is largely retained within the banks of Jacksons Creek, however inundation occurs around the low lying areas of the Serpentine Creek System.

Figure 7.6a: *Maximum Water Depth Baseline Condition 100 Year ARI Regional Flood MHWS Tailwater.*



Floodplain inundation occurs adjacent to Battery Drain upstream of Airport Drive. The inundation in these areas occurs due to a combination of the flow constriction through the culvert crossing of Airport Drive and high water level conditions from flood flows adjacent Schulz Canal and Kedron Brook Floodway. Inundation in this area is largely bounded by existing developments along Airport Drive, but some inundation of Lomandra Drive (typically less than 200 mm depth) occurs from the Airport Drive interchange to Cassia Place.

7.6.1.2 Maximum Flood Level

Maximum water surface elevations for baseline conditions, for a 100 year ARI regional flooding event (with MHWS tailwater condition) at key points throughout the study area are shown in **Table 7.6a**). **Figure 7.6b** provides the location of each point.

Table 7.6a: Maximum Flood Level for Baseline Conditions (100 year ARI Regional Flood Event with MHWS Tailwater).

Location ID	Description	Maximum Flood Level 100 Year ARI Regional MHWS (m AD)
A	Kedron Brook Floodway at Bramble Bay	1.90
B	Kedron Brook Floodway at Nudgee Golf Course Constriction	2.58
C	Kedron Brook Floodway at Kedron Brook Floodway Drain	2.70
D	Kedron Brook Floodway downstream of Transition Structure from Schulz Canal	3.52
E	Schulz Canal downstream of Gateway Motorway	4.62
F	Battery Drain downstream of Airport Drive	4.03
G	Nudgee Golf Course adjacent Kedron Brook Floodway	2.63
H	Nudgee Golf Course (centre)	2.63
I	Nudgee Golf Course adjacent Gateway Motorway	No Water
J	Floodplain adjacent Toombul Road Interchange	3.95
K	Battery Drain downstream of Gateway Motorway	4.14
L	Battery Drain upstream of Airport Drive	4.14
M	Landers Pocket Area	3.85
N	Landers Pocket Area	3.61
O	Landers Pocket upstream of Kedron Brook Floodway Drain	3.33
P	Cannery Drain downstream of Gateway Motorway	3.87

7.6.1.3 Maximum Velocity

The typical maximum open channel flow velocities along Kedron Brook Floodway under baseline conditions (100 year ARI regional flood event with MHWS tailwater) range between 1.0 m/s and 1.5 m/s. These velocities are depth averages and higher velocities may occur locally throughout the drainage system and in the vicinity of hydraulic structures such as culverts and bridges.

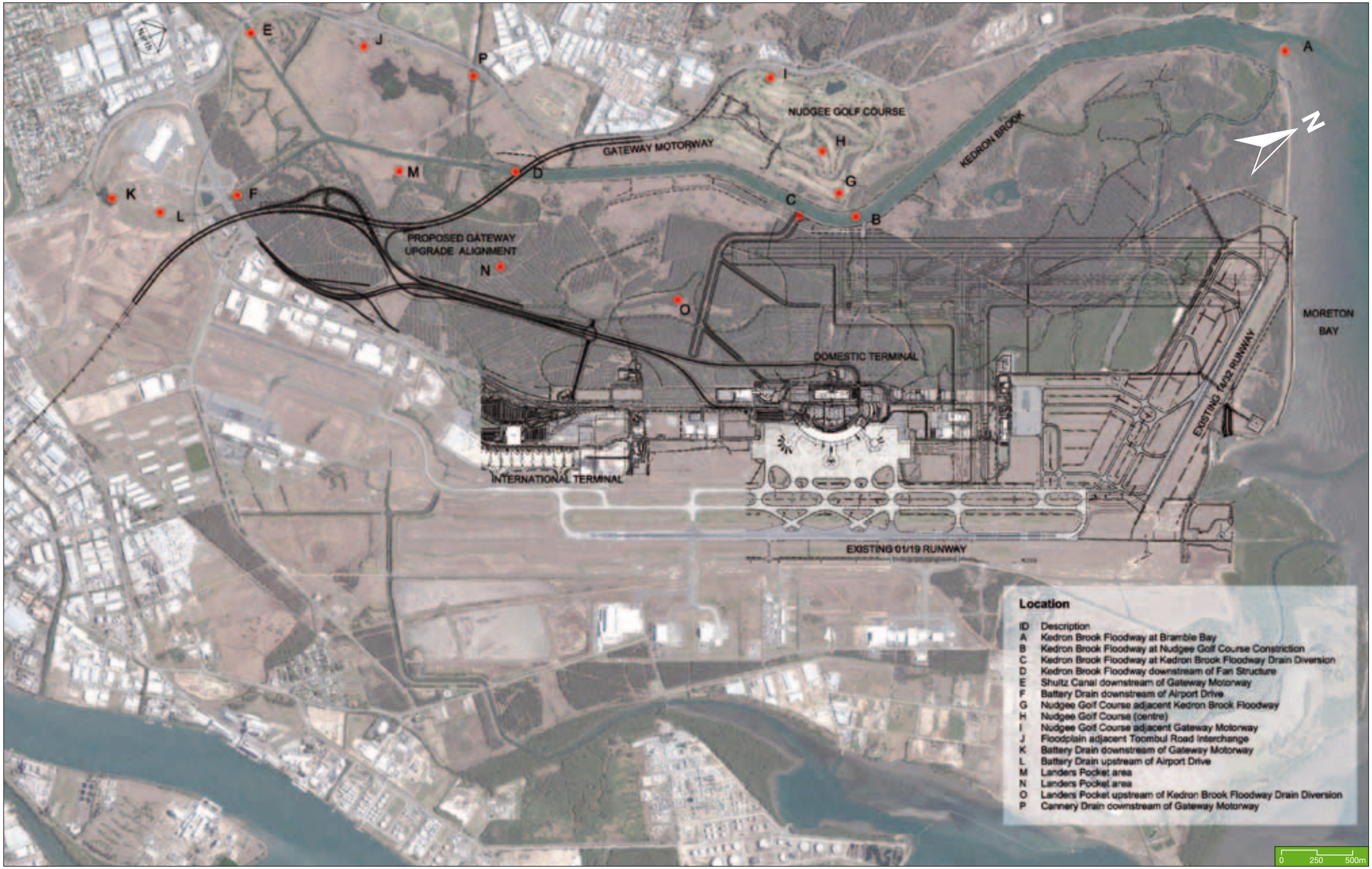
The maximum flow velocity in Schulz Canal immediately downstream of the Gateway Motorway crossing ranges between 2 m/s to 3 m/s for baseline conditions (during a 100 year ARI regional flood event with MHWS tailwater condition).

The maximum velocities at key locations are presented in **Table 7.6b** (refer to **Figure 7.6b** for the location of each point).

Table 7.6b: Maximum Velocity for Baseline Conditions (100 year ARI Regional Flood Event with MHWS Tailwater).

Location ID	Description	Maximum Velocity 100 Year ARI Regional MHWS (m/s)
A	Kedron Brook Floodway at Bramble Bay	0.83
B	Kedron Brook Floodway at Nudgee Golf Course Constriction	1.62
C	Kedron Brook Floodway at Kedron Brook Floodway Drain	1.59
D	Kedron Brook Floodway downstream of Transition Structure from Schulz Canal	1.38
E	Schulz Canal downstream of Gateway Motorway	2.50
F	Battery Drain downstream of Airport Drive	0.38
G	Nudgee Golf Course adjacent Kedron Brook Floodway	0.14
H	Nudgee Golf Course (centre)	0.08
I	Nudgee Golf Course adjacent Gateway Motorway	No Flow
J	Floodplain adjacent Toombul Road Interchange	0.44
K	Battery Drain downstream of Gateway Motorway	0.70
L	Battery Drain upstream of Airport Drive	0.34
M	Landers Pocket Area	0.32
N	Landers Pocket Area	0.18
O	Landers Pocket upstream of Kedron Brook Floodway Drain	0.11
P	Cannery Drain downstream of Gateway Motorway	1.87

Figure 7.6b: *Flood Reference Point Location.*



NEW PARALLEL RUNWAY DRAFT EIS/MDP
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7.6.2 On-Airport Flooding (Local Flooding)

The existing developed areas of Brisbane Airport have a high proportion of impervious runoff surfaces and are characterised by very low lying drainage systems with low topographic relief. Drainage of these areas occurs through a network of open channels and piped drainage. The piped drainage predominantly services the existing passenger terminal and aviation facilities and generally discharges to the open channel drainage network. The open channel drainage system services the existing terminal aprons, taxiways and runways, and is used for conveyance of piped drainage inputs from terminal infrastructure.

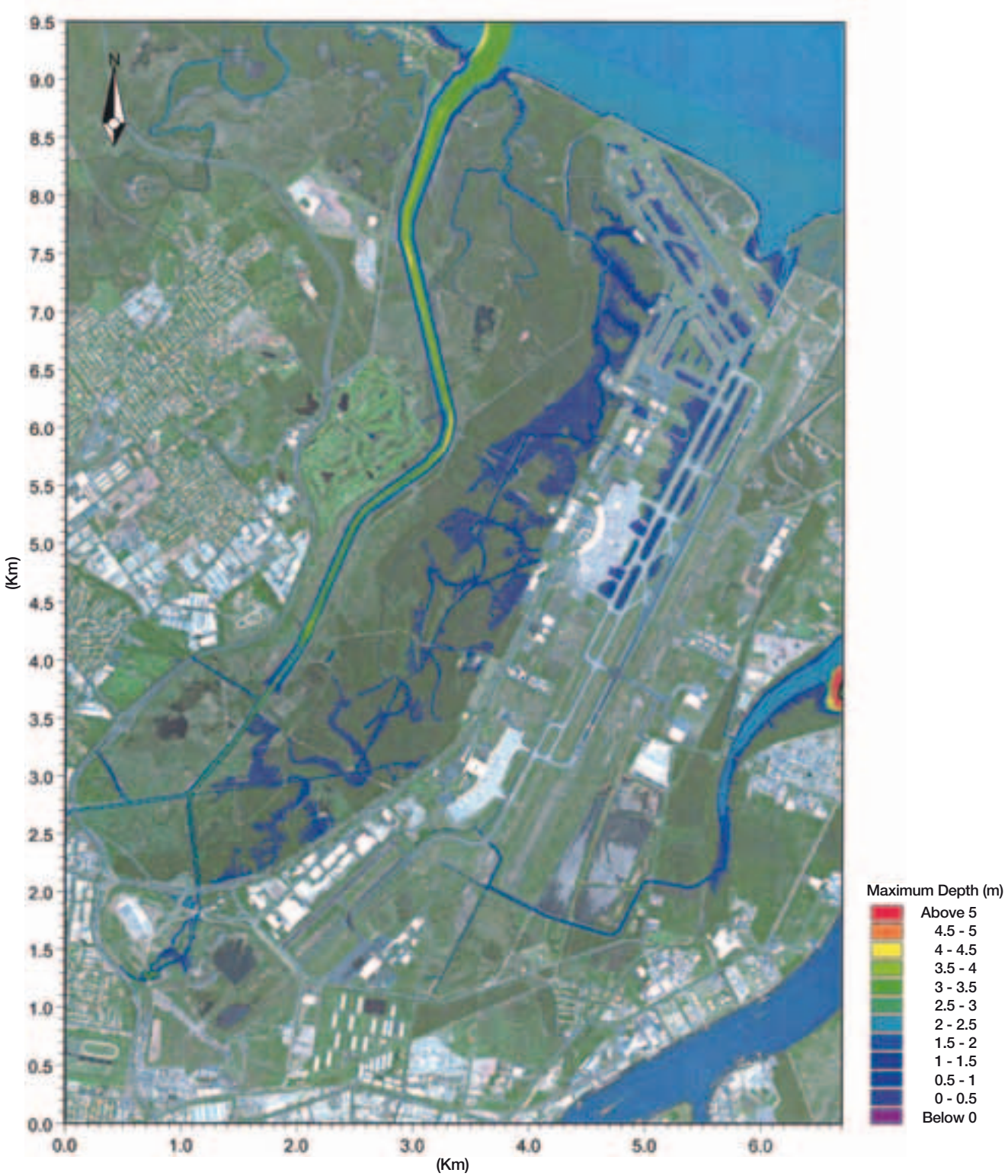
The airside infrastructure in the domestic terminal precinct is drained through an open channel located between the parallel taxiways that service the existing 01/19 runway pavements. This main airside drain discharges to Serpentine Inlet, a small embayment within Bramble Bay. Airside infrastructure in the international terminal precinct drains to Boggy Creek. The existing General Aviation area and 14/32 runway each drain through a network of open channels to the Serpentine Creek/Jacksons Creek system and discharge from Jacksons Creek at the mouth of Kedron Brook Floodway.

The formation levels of the existing 01/19 and 14/32 runways and the domestic and international terminal aprons are above the local 100 year ARI flood levels (with MHWS tailwater condition). Regional flows are not directed through the existing airside drainage infrastructure and therefore do not significantly affect local flood conditions. The maximum water depth for the 100 year ARI local flood event with MHWS tailwater condition is presented in **Figure 7.6c**.

Significant out-of-bank inundation occurs to the grassed detention storage areas between the existing 01/19 runway and supporting taxiway system. The inundation of these areas results from relatively high tailwater conditions (tide level) at the outlet of the drainage system combined with low elevation of drainage infrastructure. Ground settlement since the original construction may have contributed to the levels of inundation.

The flow velocity in the airside drainage system is typically low as a result of the very flat bed slope of drainage infrastructure. BAC's operational experience suggests that significant siltation has occurred within airport drainage infrastructure. Localised velocity increases occur around hydraulic structures such as culverts and piped components. The maximum section averaged flow velocities in the open channel drainage system around the airside facilities are of the order of 0.1 m/s. Localised velocity increases are experienced around hydraulic structures. Around local drainage hydraulic structures, the section averaged velocity typically increases to between 0.2 m/s and 0.4 m/s for a 100 year ARI local flood event (MHWS tailwater condition).

Figure 7.6c: *Maximum Water Depth Baseline Condition 100 Year ARI Local Flood MHWS Tailwater.*



7.7 Policies and Guidelines

A summary of the Policies and Guidelines as they apply to this assessment of surface water hydrology and hydraulics is summarised below.

7.7.1 Brisbane Airport Master Plan (2003)

The *Airports Act 1996* governs airport development through applying, adopting or incorporating (with or without modification) general industry standards, codes, and State law. Under the *Airports Act*, an Airport Master Plan is required outlining the future land use planning for the Airport. The Brisbane Airport Master Plan (2003) has been made under the *Airports Act* and specifically states that:

> *"The new runway system is expected to be designed around the same drainage concept as is currently in place for the existing runways, namely the adoption of numerous small detention basins in which stormwater will pond and discharge over time into the surrounding waterways."* (Page 101)

This requirement is also stated in the Brisbane Airport Master Drainage Study (refer section 7.7.3)

7.7.2 Kedron Brook Flood Study (1995)

The Kedron Brook Flood Study (1995) was commissioned by Brisbane City Council to establish a hydrological model and hydraulic model for the entire length of Kedron Brook. A major component of this study was to modify and set Flood Regulation Lines that define the extent of development filling allowed alongside the Kedron Brook.

The Kedron Brook Flood Study modelled the Flood Regulation Lines (FRL) along both sides of Kedron Brook with the objective of managing afflux within 150 mm. The FRL at the Nudgee Golf Course was modified to reflect the impact of the original positioning of Schulz Canal. These FRL modifications resulted in increased flood levels on the Airport, but were considered acceptable as the impact was confined to the Airport and the Nudgee Golf Course without impacting upon residential development.

The Kedron Brook Flood Study is the basis for flood advice from Brisbane City Council and for management of urban development in the Kedron Brook catchment. The Brisbane City Plan (2000) reflects the FRL and waterway corridor definition along Kedron Brook near the Airport.

7.7.3 Brisbane Airport Master Drainage Study (1999)

The Brisbane Airport Master Drainage Study (1999) sets development criteria for all new airport infrastructure. The document specifies the design criteria to account for the probability of coincident events. The Brisbane Airport Master Drainage Study forms the basis of engineering design of the NPR. In summary, the design principles are:

- One in 100 year flood immunity for the taxiways and the runway; and
- One in 100 year flood immunity for all cross-drainage systems.

In addition, the objective of the NPR project is to limit flood afflux upstream of the runway development. This objective is consistent with:

- The code requirements of the Brisbane City Council City Plan 2000;
- Queensland Urban Drainage Manual (1992);
- Australian Rainfall and Runoff (1987); and
- The State Planning Policy 01/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.

7.8 Impact Assessment

Development of the NPR involves construction of fill platforms to the west of Airport Drive and Dryandra Road and includes construction of new drainage infrastructure. The NPR alters existing hydrology and hydraulic processes on the site and within interacting waterway and floodplain areas.

Changes to catchment definition and floodplain characteristics are confined to the site of the NPR and on-airport catchments that are located directly adjacent the site, such as the existing Domestic Terminal Precinct and General Aviation Area.

The Landers Pocket area to the west of Airport Drive is significant in providing flood storage during regional flooding events. Construction of fill platforms associated with the NPR has the potential to influence hydraulic processes on a regional scale by changing the storage conditions at the lower end of the Landers Pocket area. The assessment of impact (below) defines the predicted impact from NPR development.

The assessment of impacts to surface water hydrology and hydraulics is based on the design of the NPR. The NPR design was informed by hydrologic and hydraulic modelling of regional and local (on-airport) drainage systems and the design incorporates mitigation of potential flooding impacts (including the Kedron Brook Floodway Drain and local flood storage).

The following section outlines the hydrologic and hydraulic impacts from development of the NPR. **Table 7.8** details the significance criteria for surface water hydrology and hydraulics.

Table 7.8: Surface Water Hydrology and Hydraulics – Significance Criteria.

Significance	Criteria
Major adverse	Major adverse impact is defined as an increase in maximum water surface level during a 100 year ARI regional flood event greater than 600 mm within the main channel of major waterways and in undeveloped floodplain areas, and greater than 100 mm in areas of existing off-airport residential or commercial land use. Major adverse impact is defined as an increase in the maximum velocity experienced in defined channels and floodplain areas by greater than 1.0 m/s and greater than 0.3 m/s respectively during a 100 year ARI flood event.
High adverse	High adverse impact is defined as an increase in maximum water surface level during a 100 year ARI regional flood event between 400 mm and 600 mm within the main channel of major waterways and in undeveloped floodplain areas, and between 50 mm and 100 mm in areas of existing off-airport residential or commercial land use. For the purposes of this Environmental Impact Statement, high adverse impact is defined as an increase in the maximum velocity experienced in main channels and floodplain areas by between 0.8 m/s and 1.0 m/s and between 0.15 m/s to 0.30 m/s respectively during a 100 year ARI flood event.
Moderate adverse	Moderate adverse impact is defined as an increase in maximum water surface level during a 100 year ARI regional flood event between 200 mm and 400 mm within the main channel of defined waterways and in undeveloped floodplain areas, and up to 50 mm in areas of existing off-airport residential or commercial land use. Moderate adverse impact is defined as an increase in maximum velocity experienced in defined channels and floodplain areas by between 0.5 m/s and 0.8 m/s and between 0.1 m/s to 0.15 m/s respectively during a 100 year ARI flood event.
Minor adverse	Minor adverse impact is defined as an increase in maximum water surface level during a 100 year ARI regional flood event between 100 mm and 200 mm within the main channel of defined waterways in undeveloped floodplain areas with no increase in flood levels in areas of existing off-airport residential or commercial land use. Flood levels not greater than those used by Brisbane City Council for statutory planning within the catchment. Minor adverse impact is defined as an increase in the maximum velocity experienced in defined channels and floodplain areas by between 0.2 m/s and 0.5 m/s and between 0.05 m/s to 0.1 m/s respectively during a 100 year ARI flood event.
Negligible	Negligible impact corresponds to an increase in maximum water surface level during a 100 year ARI regional flood event not greater than 100 mm within the main channel of major waterways. No increase in the flood level within existing off-airport residential or commercial land use. Negligible impact is defined as an increase in the maximum velocity experienced in main channels and floodplain areas not more than 0.2 m/s and 0.05 m/s (respectively) during a 100 year ARI flood event.
Beneficial	Maximum flood level in stream channels and floodplain areas is reduced as a result of the NPR development, with a corresponding decrease in flood risk and increase in social and environmental amenity. The velocity profile within waterways is altered to improve stream bed and bank stability and reduce public safety risk.

7.8.1 Regional Flooding

Under development of the NPR, Brisbane Airport maintains major interaction with Kedron Brook Floodway and Landers Pocket Drain during large regional flood events. The flood inundation area experienced under developed conditions (development of the NPR) is similar to that experienced under baseline conditions with the exception of the disparity within the on-airport Serpentine Creek system, owing to development of the NPR.

7.8.1.1 Flood Inundation

A 100 year ARI regional flood event with development of the NPR causes inundation in a number of areas throughout the lower Kedron Brook floodplain that each experience inundation under baseline conditions (prior to development of the NPR). **Figure 7.8a** shows the inundation (maximum flood depth) experienced with development of the NPR (during a 100 year ARI regional flood with MHWS tailwater condition). **Figure 7.8a** shows inundation during this flood event is experienced in:

- The floodplain area west of Schulz Canal, bounded by the Gateway Motorway;
- The floodplain area to the east of Schulz Canal, bounded by Airport Drive and the Gateway Motorway;
- The Landers Pocket area to the east of Schulz Canal and Kedron Brook Floodway bounded by Airport Drive, downstream to the Kedron Brook Floodway Drain;
- The Nudgee Golf Course Floodplain area; and
- The Battery Drain area upstream of Airport Drive.

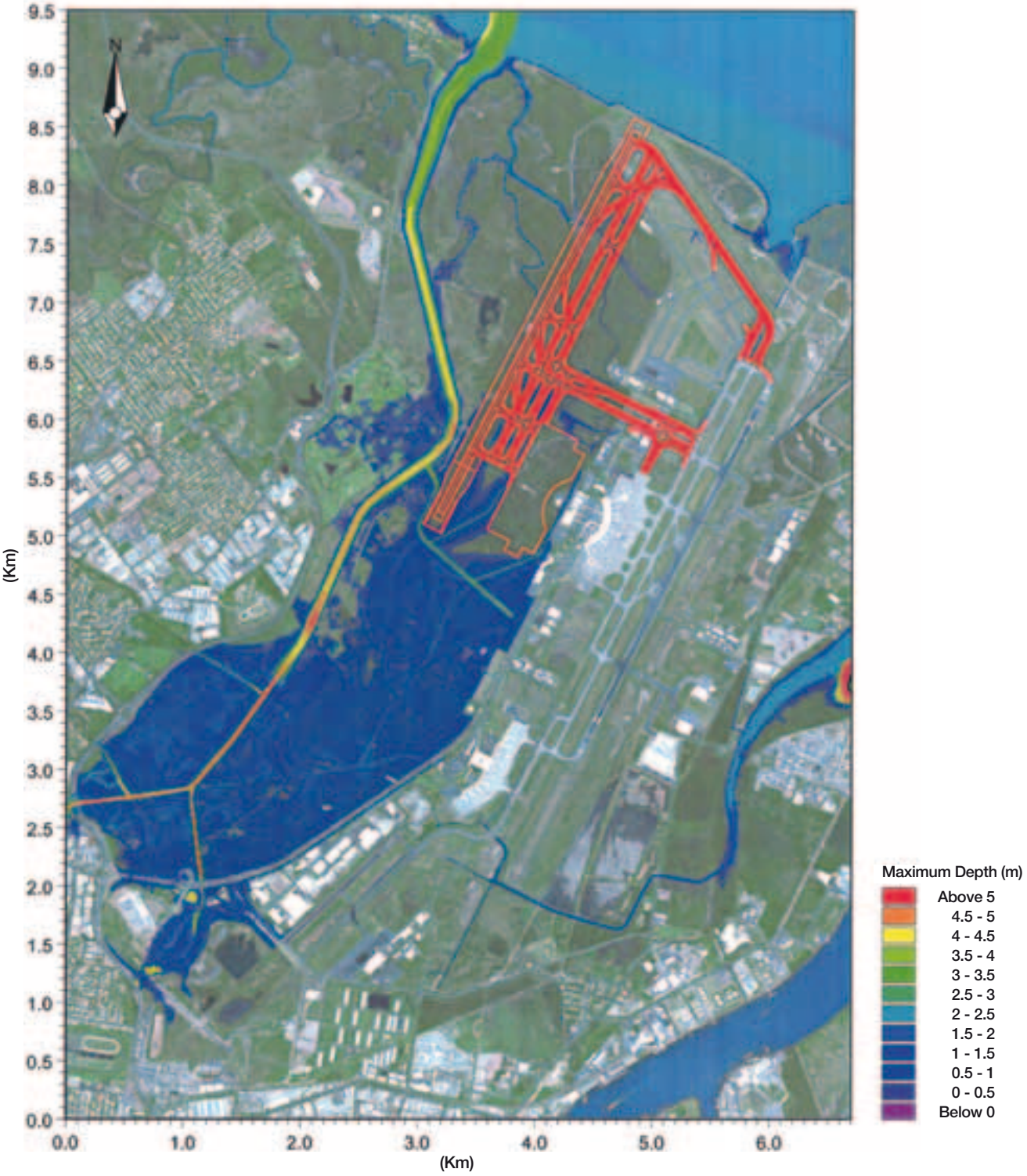
Flood and inundation characteristics to the west of Schulz Canal under NPR development conditions are similar to the baseline condition. The hydraulic capacity of Schulz Canal is insufficient to convey the 100 year ARI discharge within the channel banks, resulting in out-of-bank (overland) flow through the low-lying floodplain areas. Overland flow through the area remains confined by the Gateway Motorway road embankment. There is no significant difference in the maximum water surface level throughout this area (refer Location E, Location J and Location P) under developed conditions, compared to baseline conditions. The Gateway Motorway road embankment constrains flows near the inlet to the Kedron Brook Floodway, and forces much of the overland flow on the western floodplain into the Floodway. The hydraulic capacity of the floodway is adequate to maintain flow within the channel during a 100 year ARI regional flood event (with MHWS tailwater).

The inundation and flood characteristics on the eastern side of Schulz Canal upstream of the inlet to Kedron Brook Floodway under development of the NPR is similar to that experienced under baseline conditions. Overland flow through the floodplain area remains confined by the Gateway Motorway and Airport Drive. Overland flow on the eastern side can partially flow through the inlet to the Kedron Brook Floodway whilst the remaining flows continue through the Landers Pocket area.

Construction of the Kedron Brook Floodway Drain intercepts the overland flows through the Landers Pocket area upstream of the NPR development. Under baseline conditions, overland flow through the Landers Pocket area flows through to the Serpentine Creek and Jacksons Creek system of tidal channels and rejoins Kedron Brook Floodway at Moreton Bay. Under developed conditions, construction of Kedron Brook Floodway Drain and large fill platforms associated with the NPR development will divert the overland flows into the Kedron Brook Floodway opposite Nudgee Golf Course.

The Kedron Brook Floodway Drain diverts all overland flow through the Landers Pocket area upstream of the NPR development to the main channel of Kedron Brook Floodway near the Nudgee Golf Course bend. The resultant increase in discharge through Kedron Brook Floodway will be likely to produce an increase in the maximum water surface level within the floodway around the confluence of Kedron Brook Floodway Drain. The extent of inundation in off-airport residential and commercial areas would not be affected by construction of the NPR (refer section 7.8.1.2).

Figure 7.8a: *Maximum Water Depth Developed Condition 100 Year ARI Regional Flood MHWS Tailwater.*



7.8.1.2 Maximum Flood Level

Maximum water surface levels for developed conditions depicting construction of the NPR, for a 100 year ARI regional flood event (with MHWS tailwater condition) are shown in **Table 7.8a** (refer **Figure 7.6b** for the location of each point). **Table 7.8a** also outlines the flood afflux (change in maximum water surface level) between baseline and developed conditions.

Table 7.8a: Maximum Flood level for Developed Conditions 100 year ARI Regional Flood Event with MHWS Tailwater.

Location ID	Description	Maximum Flood Level 100 Year ARI Regional MHWS (m AD)	Flood Afflux (m)
A	Kedron Brook Floodway at Bramble Bay	1.90	0.00
B	Kedron Brook Floodway at Nudgee Golf Course Constriction	2.68	0.10
C	Kedron Brook Floodway at Kedron Brook Floodway Drain	2.88	0.18
D	Kedron Brook Floodway downstream of Transition Structure from Schulz Canal	3.54	0.02
E	Schulz Canal downstream of Gateway Motorway	4.62	0.00
F	Battery Drain downstream of Airport Drive	4.03	0.00
G	Nudgee Golf Course adjacent Kedron Brook Floodway	2.76	0.13
H	Nudgee Golf Course (centre)	2.77	0.14
I	Nudgee Golf Course adjacent Gateway Motorway	2.66	0.13
J	Floodplain adjacent Toombul Road Interchange	3.95	0.00
K	Battery Drain downstream of Gateway Motorway	4.14	0.00
L	Battery Drain upstream of Airport Drive	4.14	0.00
M	Landers Pocket Area	3.85	0.00
N	Landers Pocket Area	3.63	0.02
O	Landers Pocket upstream of Kedron Brook Floodway Drain	3.53	0.20
P	Cannery Drain downstream of Gateway Motorway	3.87	0.00

The results in **Table 7.8a** indicate that the development of the NPR has negligible to minor impacts on maximum water levels at the specific reference locations. Small increases in water levels occur at the following reference locations:

- The main channel of Kedron Brook Floodway, immediately upstream and downstream of the Kedron Brook Floodway Drain confluence (including Location B and Location C). Location D shows only a very small increase in maximum flood level;
- The Nudgee Golf Course floodplain area (including Location G, Location H and Location I); and
- The Landers Pocket area, immediately upstream of Kedron Brook Floodway Drain (Location N and Location O).

The small increases in maximum flood level occur at locations within the main channel of waterways and in floodplain areas that are either undeveloped or developed for recreational amenity (Landers Pocket area and Nudgee Golf Course Floodplain respectively), and are generally less than 150 mm for a 100 year ARI regional flood event (MHWS tailwater).

Figure 7.8b shows the predicted maximum flood level along the main channel of Kedron Brook Floodway for the following scenarios:

a) NPR Project – Baseline Conditions (100 year ARI regional flood with MHWS tailwater);

b) NPR Project – Developed Conditions (100 year ARI regional flood event with MHWS tailwater); and

c) Kedron Brook Flood Study (1995) – Ultimate Conditions (100 year ARI regional flood event with MHWS tailwater).

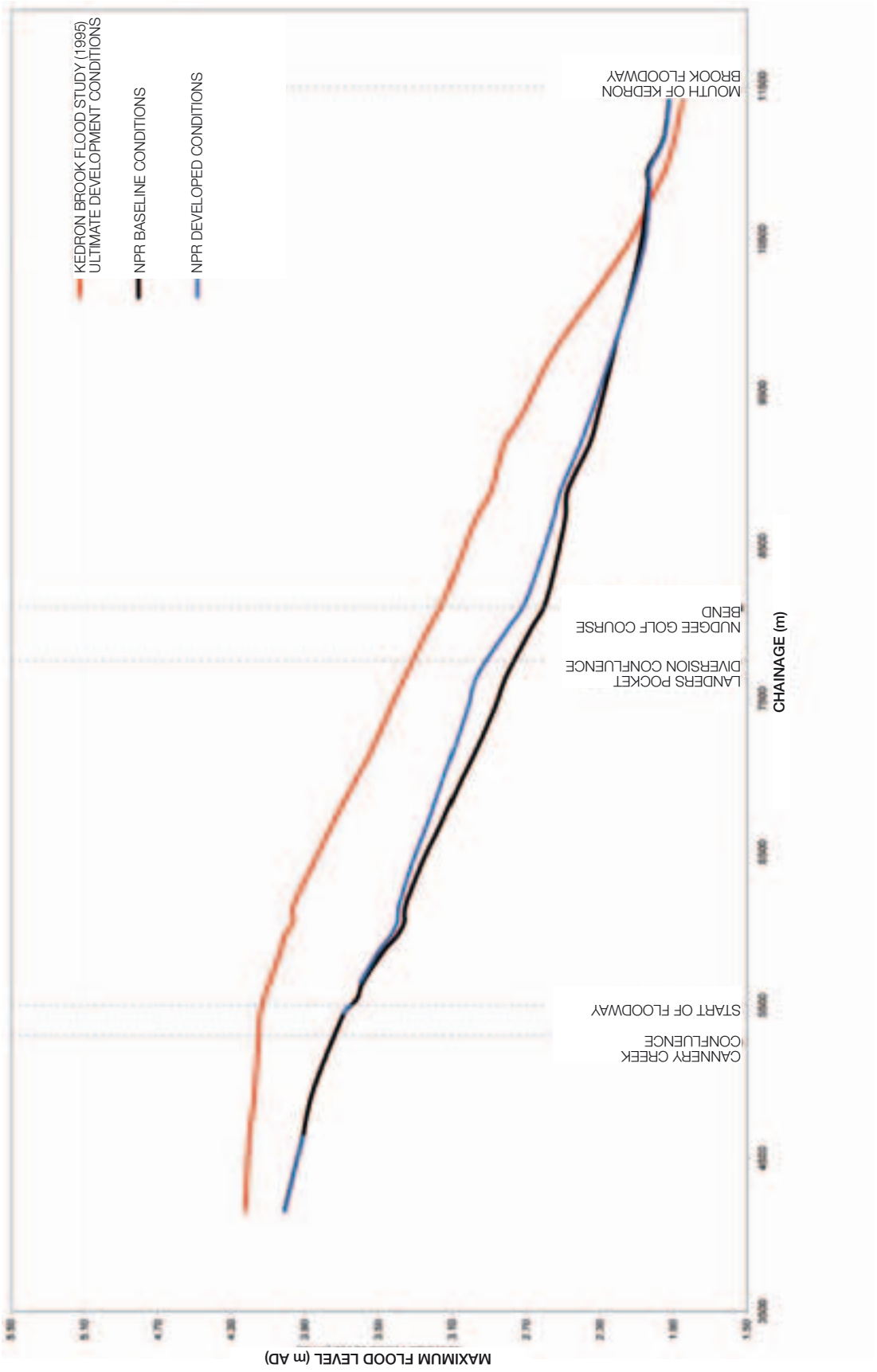


Figure 7.8b: *Maximum Flood Level Profiles for Kedron Brook Floodway.*

The convergence of the Developed Conditions maximum water level to the Baseline Conditions maximum water level around the start of Kedron Brook Floodway shows that development of the NPR has no impact on maximum flood level upstream of Kedron Brook Floodway, in accordance with the predictions of the numerical modelling. Maximum flood level predicted under development of the NPR is below the maximum level documented in the Kedron Brook Flood Study (1995).

7.8.1.3 Maximum Velocity

Velocities within the channel system for a 100 year ARI regional flood event (with MHWS tailwater condition) range between approximately 1.0 m/s and 1.5 m/s. These velocities are similar to the velocity characteristics occurring under baseline conditions.

The Kedron Brook Flood Study reports average stream velocities in the lower reach of Kedron Brook Floodway between 0.9 m/s and 1.6 m/s with the lower velocities occurring closer to the outlet in Moreton Bay. Velocity conditions in the Kedron Brook Floodway under developed conditions are consistent with the Kedron Brook Flood Study and accordingly the numerical modelling demonstrates that development of the NPR will not significantly change the existing scour and deposition characteristics within Kedron Brook Floodway.

Overland flow velocities are consistent with baseline overland flow velocity, ranging between approximately 0.2 m/s to 0.5 m/s.

The impacts to maximum velocity at the specific reference locations are presented in **Table 7.8b** which details the difference between baseline and developed velocity conditions, based on modelling with a MHWS tailwater condition (refer **Figure 7.6b** for the location of each point).

There may be marginal increases in velocity under lower tide conditions, however the impact from development of the NPR will remain similar within this velocity range.

Table 7.8b: Maximum Velocity and Velocity Impact for a 100 year ARI Regional Flood Event with Development of the NPR (MHWS Tailwater) (m/s).

Location ID	Description	Maximum Velocity 100 Year ARI Regional MHWS (m/s)	Velocity Impact (m/s)
A	Kedron Brook Floodway at Bramble Bay	0.82	0.00
B	Kedron Brook Floodway at Nudgee Golf Course Constriction	1.74	0.12
C	Kedron Brook Floodway at Kedron Brook Floodway Drain	1.54	-0.05
D	Kedron Brook Floodway downstream of Transition Structure from Schulz Canal	1.34	-0.04
E	Schulz Canal downstream of Gateway Motorway	2.50	0.00
F	Battery Drain downstream of Airport Drive	0.37	0.00
G	Nudgee Golf Course adjacent Kedron Brook Floodway	0.20	0.06
H	Nudgee Golf Course (centre)	0.12	0.05
I	Nudgee Golf Course adjacent Gateway Motorway	0.01	0.01
J	Floodplain adjacent Toombul Road Interchange	0.44	0.00
K	Battery Drain downstream of Gateway Motorway	0.69	-0.01
L	Battery Drain upstream of Airport Drive	0.35	0.01
M	Landers Pocket area	0.32	0.00
N	Landers Pocket area	0.17	0.00
O	Landers Pocket upstream of Kedron Brook Floodway Drain	0.11	0.00
P	Cannery Drain downstream of Gateway Motorway	1.87	0.00

Table 7.8b shows negligible to minor velocity impacts from development of the NPR. Small changes in velocity occur at the following locations:

- Kedron Brook Floodway around the Nudgee Golf Course constriction (Location B);
- The Nudgee Golf Course floodplain area (including Location G, Location H and Location I); and
- Battery Drain upstream of Airport Drive (Location L).

Construction of the Kedron Brook Floodway Drain enables the re-direction of overland flows within the Landers Pocket area to the Kedron Brook Floodway. The additional flows in the floodway result in a localised velocity increase around the confluence of Kedron Brook Floodway Drain and Kedron Brook Floodway. The increased flows in the floodway also contribute to increased overland flow velocities through Nudgee Golf Course floodplain. However the increases are small relative to the baseline conditions.

A small reduction in channel flow velocity occurs immediately downstream of the inlet to Kedron Brook Floodway (Location D). The channel flow velocities in this area are reduced because of changes in the water surface slopes of Kedron Brook Floodway and adjacent floodplain areas.

The velocity impacts that result from development of the NPR are small and are not expected to produce adverse impacts.

7.8.2 On-Airport Flooding (Local Flooding)

The drainage infrastructure for the NPR development is largely independent of existing airport drainage systems servicing existing aiport infrastructure. Accordingly, the impact of development on water surface level and flow velocity throughout the existing airport drainage is negligible. However, the local (on-airport) drainage network servicing the NPR alters the existing Landers Pocket Drain, Serpentine Creek and Jacksons Creek systems that currently provide local drainage of airport infrastructure.

The local (on-airport) drainage infrastructure servicing the NPR is designed with a similar functionality to the drainage infrastructure servicing the existing 01/19 runway.

The formation level of the NPR is above the 100 year ARI local flood level, and construction of the Kedron Brook Floodway Drain prevents regional 100 year ARI flows from adversely impacting airport drainage infrastructure of the NPR. **Figure 7.8c** shows the maximum water depth for a 100 year ARI local flood event with MHWS tailwater condition. **Figure 7.8c** shows that inundation occurs in the detention storage areas within the runway and taxiway system as expected. Inundation in the detention storage areas is a deliberate intent of the drainage design of the NPR in order to attenuate peak discharge from airport drainage catchments to major drainage paths and receiving waters. Inundation in the detention areas occurs for a period of approximately four hours for a 100 year ARI design event. This is consistent with the design criteria specified in Brisbane Airport Master Drainage Study (1999) that specifies ponding for not greater than 12 hours. Inundation in the detention areas does not encroach onto runway and taxiway pavements during a 100 year ARI flood event with MHWS or HAT tailwater.

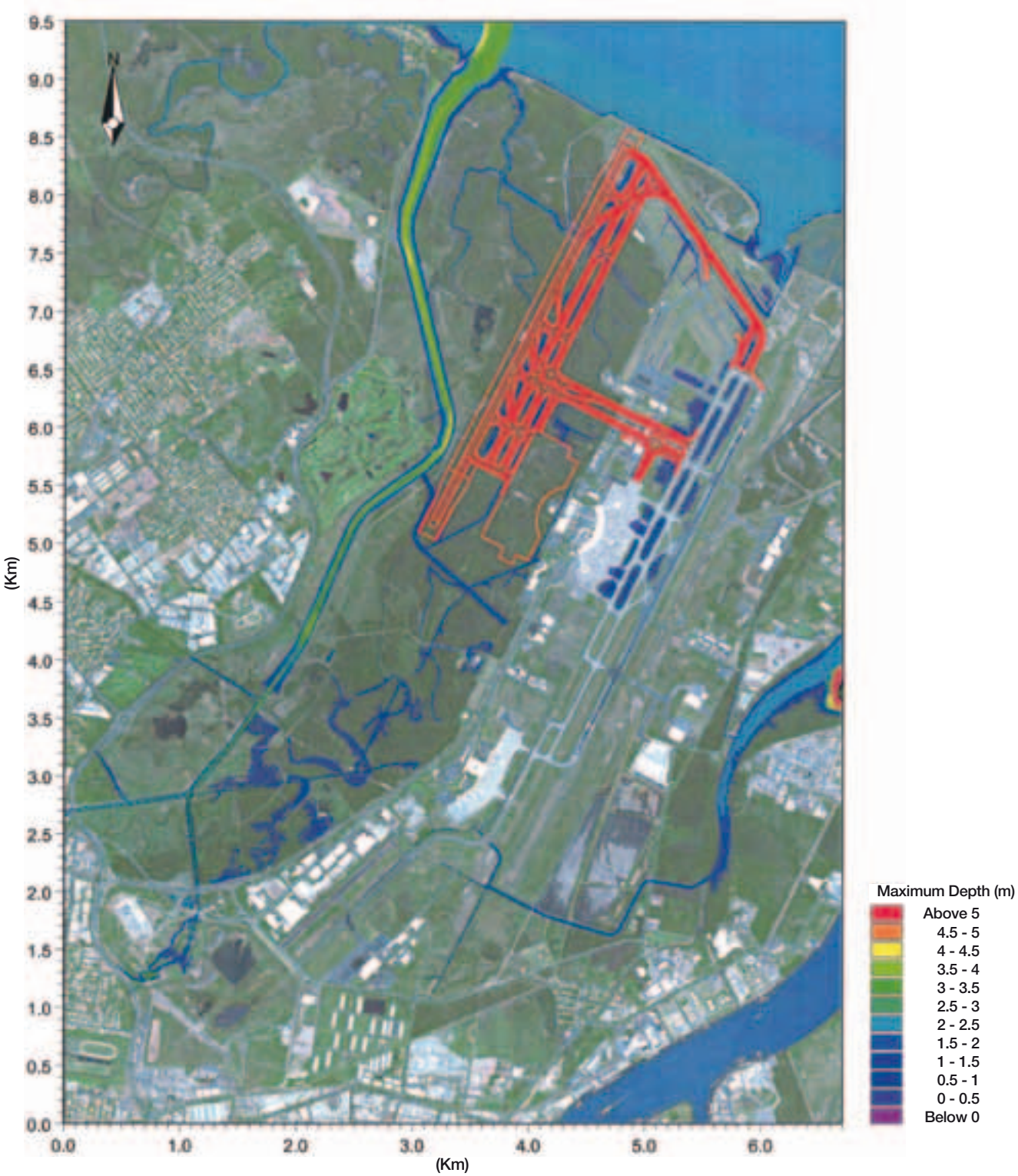
Maximum cross-section averaged velocity in the airport drainage system is typically less than 1 m/s, with localised increased up to approximately 1.5 m/s around hydraulic structures (typically culverts) used for conveyance of flow below taxiway pavements.

7.8.3 Comparison with Kedron Brook Flood Study

7.8.3.1 Maximum Flow Rate

The design criteria for the Kedron Brook Floodway were defined by a Joint Government Coordinating Committee in 1979. The committee adopted a peak discharge of 740 m^3/s at Nudgee Road, based on the 1974 flood that was assumed to represent an equivalent one in 100 year ARI event. This peak flow rate is reflected in the Kedron Brook Flood Study (1995).

Figure 7.8c: *Maximum Water Depth Developed Condition 100 Year ARI Local Flood MHWS Tailwater.*



The outcomes of numerical modelling undertaken as part of the Kedron Brook Flood Study (1995) have been adopted in this assessment to establish regional stream flow for Schulz Canal, Pound Drain, Battery Drain and Cannery Creek, based on ultimate development within Kedron Brook Catchment. Accordingly, the peak flow estimate in the NPR model is consistent with the Kedron Brook Flood Study (1995).

7.8.3.2 Maximum Flood Level

The Kedron Brook Flood Study (1995) is Brisbane City Council's principal tool for flood planning in Kedron Brook Catchment. The Kedron Brook Flood Study (1995) defines the maximum flood level along Kedron Brook and its tributaries and development scenarios within the catchment that are acceptable in a planning context.

Development within the lower Kedron Brook Catchment that is either (i) consistent with Brisbane City Council's planning policies or (ii) maintains maximum flood levels that are consistent with the Kedron Brook Flood Study (1995) may be considered acceptable. Development of the NPR is consistent with the provisions of Brisbane City Council planning that allows filling to the boundary of waterway corridors and does not result in maximum flood levels that exceed those documented in the Kedron Brook Flood Study (1995).

This assessment of hydrologic and hydraulic impacts from development of the NPR has been compared to acceptable impacts defined in the Kedron Brook Flood Study (1995) (namely, the outcomes of ultimate development presented in study). **Figure 7.8b** shows a comparison between the maximum flood levels along Kedron Brook Floodway as presented in the Kedron Brook Flood Study (1995) and maximum flood levels predicted in numerical modelling of baseline conditions and developed conditions for the NPR. **Figure 7.8b** shows that each of these developments results in maximum flood levels that are below the maximum level shown in the Kedron Brook Flood Study (1995) for ultimate conditions, and accordingly, development of the NPR is consistent with the provisions of the Kedron Brook Flood Study (1995).

7.8.4 Summary of Impact to Surface Water Hydrology and Hydraulics

The impact assessment shows that development of the NPR has negligible to minor impact on surface water hydrologic and hydraulic conditions within the study area, in accordance with the significance criteria for surface water hydrology and hydraulics (refer **Table 7.8**). Impacts predicted using the numerical modelling methodology are generally experienced locally around the confluence of Kedron Brook Floodway and Kedron Brook Floodway Drain, and result from diversion of overland flow from the Landers Pocket area to the main channel of Kedron Brook Floodway.

Figure 7.8b shows there is no predicted increase in maximum flood levels upstream of the start of Kedron Brook Floodway from construction of the NPR. Accordingly, construction of the NPR will not influence the maximum flood levels in existing developed areas upstream of Brisbane Airport (and upstream of the Gateway Motorway crossing of Schulz Canal and its tributaries).

The NPR has negligible impact on the maximum water level and flow velocity (for both channelised and overbank flow regimes) and the extent of inundation is unchanged from baseline conditions with the exception of the Nudgee Golf Course area and areas of the NPR which are reclaimed.

7.9 Cumulative Effects

7.9.1 Planned Future Development

Three other major developments are planned near and on Brisbane Airport, namely the Gateway Upgrade Project (GUP), Northern Access Road Project (NARP) and the Australia TradeCoast development.

The GUP incorporates duplication and realignment of some sections of the existing motorway and new access roads and connections to the existing Gateway Arterial. The GUP requires a large bridge/ major viaduct across the Kedron Brook Floodway, downstream (north) of the existing Gateway Motorway. In addition, major road embankments across the Landers Pocket floodplain are proposed.

The Northern Access Road Project (NARP) is a four lane access road from the GUP to the domestic and international terminal precincts. The project involves construction of large road embankments and a major vehicular interchange in the Landers Pocket floodplain, immediately upstream (south) of the runway site.

Australia TradeCoast is a joint initiative between the Queensland Government, Brisbane Marketing, Brisbane Airport Corporation and the Port of Brisbane. The Australia TradeCoast project includes a number of industrial and trade focussed developments around existing key infrastructure including Brisbane Airport, Port of Brisbane and the Gateway Motorway.

There are also further developments of Brisbane Airport, consistent with Brisbane Airport Master Plan (2003) within the study area. Each of these projects will influence surface water hydrology and hydraulics of the lower Kedron Brook Catchment. Refer to Chapter A1 for more detail of planned developments at the Airport.

7.9.2 Assessment of Cumulative Impact from Planned Future Development

The Kedron Brook Flood Study (1995) establishes flood regulation lines for Kedron Brook and its major tributaries. The flood regulation line documented in the Kedron Brook Flood Study (1995) is based on ultimate development within the upper and lower Kedron Brook catchment. Ultimate development in the upper catchment influences the hydrologic response of the catchment and will affect stream flow. Ultimate development in the lower catchment influences hydraulic response and will affect the extent of flood inundation and maximum flood levels in the lower floodplain areas.

Provisions within Brisbane City Council planning allow for filling to the boundary of Waterway Corridors (defined by the Flood Regulation Line for Kedron Brook Floodway). Planned future development within the study area is consistent with this provision, and accordingly it is anticipated that the cumulative impact from combined GUP, NARP, Australia TradeCoast and future aiport development will be consistent with the outcomes of the Ultimate Development scenario assessed in the Kedron Brook Flood Study (1995).

The cumulative impact to hydrology and hydraulics from future planned development in the lower catchment has not been quantitatively assessed as part of this study. Development of the NPR shows only localised and minor impact to regional hydrology and hydraulics. The NPR is unlikely to result in flooding impact when combined with other planned development in the study area that is significantly different from the impact of the runway development in isolation.

Impacts to hydrology and hydraulics from future planned development in the lower Kedron Brook Catchment is subject to on-going assessment as part of the Australia TradeCoast development. The Australia TradeCoast has commissioned a drainage and fill assessment for the northern part of the Australia TradeCoast area. The study area for the Northern Australia TradeCoast drainage and fill assessment partly coincides with the study area for the NPR and incorporates the northern part of the Australia TradeCoast area, GUP, NARP and Brisbane Airport. Cumulative impact from planned future development within the lower catchment will be addressed as part of the Northern Australia TradeCoast drainage and fill assessment.

7.9.3 Northern Australia TradeCoast Drainage and Fill Assessment

The Northern Australia TradeCoast drainage and fill assessment is an on-going investigation that has been commissioned to provide a coordinated approach to management of flooding and establish a fill strategy for the overall Australia TradeCoast area. The NPR site is included within the study area for the Northern Australia TradeCoast assessment.

In establishing the approach to management of flooding and a fill strategy for the Northern Australia TradeCoast area, the Northern Australia TradeCoast drainage and fill assessment will define cumulative impacts to flooding from combined future development in the lower catchment. Cumulative impacts from planned future development can not be adequately addressed as part of the NPR assessment of hydrology and hydraulics, as development within the study area will be partly defined by the outcomes of the Northern Australia TradeCoast assessment.

The cumulative impact to hydrology and hydraulics from combined development of the NPR with Australia TradeCoast, GUP, NARP and future airport development will be assessed in the Northern Australia TradeCoast assessment. Documentation of this assessment will define cumulative impact relevant to development of the NPR.

7.10 Mitigation

The preliminary design of the NPR was based on a flooding assessment that incorporated hydrologic and hydraulic modelling of local (on-airport) and regional drainage systems under existing and developed conditions. Flooding assessment undertaken during preliminary design was needed to define the appropriate elevation of the NPR and associated infrastructure to provide specific flooding immunity and to validate the preliminary design of airport drainage infrastructure. The flooding assessment also allowed potential hydrologic and hydraulic impacts from the NPR to be mitigated through design.

The flooding assessment undertaken during NPR design identified two potential impacts from development of the NPR, which included:

- Interception of regional overland flow through the Landers Pocket floodplain area due to construction of significant fill platforms; and
- Potential for increased stormwater runoff from impervious runway and taxiway pavements.

The design of the NPR included two specific components to mitigate these potential impacts. The design included:

- Kedron Brook Floodway Drain, which intercepts regional overland flow through the Landers Pocket area upstream of the NPR project; and
- Local (on-airport) drainage detention storage areas, which provide attenuation of peak flows through the local drainage network and reduce the impact of the NPR on existing drainage systems by reducing the peak discharge from the NPR drainage infrastructure.

7.10.1 Kedron Brook Floodway Drain

Kedron Brook Floodway Drain is a key component of flooding mitigation infrastructure that prevents inundation of the NPR area. The diversion drain intercepts overland flows passing through the Landers Pocket floodplain and diverts the flow to the main channel of the Kedron Brook Floodway. The function of Kedron Brook Floodway Drain is consistent with the design intent of Kedron Brook Floodway, which was designed to contain the discharge from Kedron Brook catchment within the banks of the main channel. The original design of Kedron Brook Floodway took into account the potential future construction of a runway parallel to the existing runway (in the approximate location of the NPR). The design accounted for flow from the floodplain to be carried in the main channel of Kedron Brook Floodway.

The confluence of Kedron Brook Floodway Drain and Kedron Brook Floodway is designed to avoid significant disruption to the flow regime within Kedron Brook Floodway. Any disruption to the main channel flow has the potential to cause adverse flooding impacts on adjacent areas. The velocity characteristics at the confluence of Kedron Brook Floodway Drain and Kedron Brook Floodway indicate that a smooth transition of the two channels is achieved, with negligible impact on the flow regime within Kedron Brook Floodway. The Kedron Brook Floodway Drain effectively intercepts overland flow through the Landers Pocket floodplain and mitigates the potential impact from construction of the NPR without causing significant impact around the confluence with Kedron Brook Floodway or along the alignment of the channel.

7.10.2 On-Airport (Local Drainage) Peak Flow Attenuation

Construction of runway and taxiway pavements has the potential to increase stormwater runoff resulting from increased impervious area. The design of on-airport drainage infrastructure for the NPR includes significant detention areas (flood storage areas) between runway and taxiway pavements that attenuate the peak flow from local airport drainage catchments. Attenuation of peak flow through the drainage system reduces the impact of local drainage on regional drainage systems, including Kedron Brook Floodway.

7.10.3 Summary of Mitigation

The design of the NPR was based on flooding assessment that allowed mitigation of potential hydrologic and hydraulic impacts to be incorporated into the design. As a result, the NPR project has negligible impact on hydrologic and hydraulic surface water processes (refer section 7.8). The hydrologic and hydraulic impacts of the NPR are consistent with the provisions of Brisbane City Plan (2000) for ultimate development within Kedron Brook Catchment (refer section 7.8).

7.11 Residual Effects

Mitigation of potential hydrologic and hydraulic impact is incorporated in the design of the NPR. There are no significant impacts to surface water hydrology and hydraulics that result from the development of the NPR. Consequently, mitigation measures are not required to ameliorate impact.

7.12 Assesment Summary Matrix

Table 7.12 lists an assessment summary matrix for surface hydrology issues.

Table 7.12: Surface Hydrology Assessment Summary Matrix.

EIS Area: Surface Water Hydrology and Hydraulics Feature/ Description	Existing Condition + Substitutable Y:N	Description of Impact			Additional Compensation (Beyond Standard Practice)
		Impact	Mitigation Inherent in Design/Standard Practice Amelioration	Significance Criteria	
Spatial extent of flooding within Kedron Brook Floodway and adjacent floodplain areas; Off-airport peak flood level and velocity.	Inundation experienced in floodplain areas adjacent Kedron Brook Floodway. Not substitutable.	Localised negligible/minor impacts to flood extents within Kedron Brook Floodway and adjacent floodplain.	Construction of Kedron Brook Floodway Drain; On-airport peak flow attenuation.	Negligible/minor.	Nil
On-airport flooding.	Inundation retained within stormwater detention storage areas. Not substitutable.	No worsening of existing conditions.	On-airport peak flow attenuation through provision of detention storage areas.	No adverse impact to on-airport flooding.	Nil

References

Australian Runoff Quality – A Guide to Water Sensitive Urban Design, Institute of Engineeers Australia, Sydney, 2005.

Sediment Basin Design Guidelines, Construction and Maintenance Guidelines, Brisbane City Council, Brisbane, 2001.

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